Reference

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Modelling Dynamic e-Business Applications Using Historical Performance Data
D.Bacigalupo, J.D.Turner, S.A.Jarvis, G.R.Nudd
19th Annual UK Performance Engineering Workshop (UKPEW03)
University of Warwick, UK, 9-10 July 2003

Distributed e-business application platforms such as the web services framework will require sophisticated workload management infrastructures for the matching of client requests to the most appropriate resources. This paper introduces a novel dynamic predictive framework that uses both historical data and analytical performance modelling to extrapolate a request's predicted performance under varying workloads and conditions on different systems. Such a framework can facilitate a workload manager in maximising the extent to which service level agreements can be met. Initial results are presented analysing how the response times of an e-business benchmark can be predicted at different system loads and on different application servers.

A Dynamic Predictive Framework for e-business Workload Management
D.Bacigalupo, J.D.Turner, S.A.Jarvis, G.R.Nudd
7th World Multiconference on Systemics,Cybernetics and Informatics (SCI2003) Performance of Web Services Invited Session,
Orlando, Florida USA, 27-30 July 2003

Distributed e-business application platforms such as the web services framework will require sophisticated workload management infrastructures for the routing of client requests to the most appropriate services. This paper introduces a novel and dynamic predictive framework that uses both analytical performance modeling and historical data to extrapolate a request's predicted performance under varying workloads and conditions. Such a framework can facilitate a routing algorithm in meeting quality of service-based metric requirements. An e-business benchmark is used as a demonstrator to provide an insight into the techniques used in predicting the response time of requests under varied workload conditions.

Grid Resource Management Information Services for Scientific Computing
H. N. Lim Choi Keung, L. Wang, D. P. Spooner, S. A. Jarvis, W. Jie and G. R. Nudd
International Conference on Scientific and Engineering Computation 2002 (IC-SEC 2002)
Raffles City Convention Centre, Singapore, December 3-5 2002.

Scientific applications typically have considerable memory and processor requirements. Nevertheless, even with today's fastest supercomputers, the power of available resources falls short of the demands of large, complex simulations and analysis. The solution fortunately lies in the emergence of innovative resource environments such as Grid computing. This paper addresses issues concerning the discovery and monitoring of resources across multiple administrative domains, which can be harnessed by scientific applications. Grid Information Services are an important infrastructure in computational Grid environments as they provide important information about the state and availability of resources. We will present how the Globus Monitoring and Discovery Service (MDS) architecture can be extended to offer a

transparent, unified view of Grid resources. Local resource managers ultimately possess the potential to influence where scientific jobs are processed, depending on the availability and load of their scheduler. Consequently, information about the structure and the state of schedulers should be provided to Grid brokers, which will then decide where to schedule the applications. This paper will present the way in which low-level scheduling information is collated from multiple sources and is incorporated into the unified Grid information view. The existence and availability of Grid resource information also allows reliable application performance prediction to be carried out using the Warwick PACE (Performance Analysis and Characterisation Environment) system. Thus, Grid Information Services are a key component in the efficient execution of scientific applications on Grid computing architectures.

Localised Workload Management Using Performance Prediction and QoS Contracts.
D. P. Spooner, J. Cao, J. D. Turner, H. N. Lim Choi Keung, S. A. Jarvis, and G. R. Nudd
Eighteenth Annual UK Performance Engineering Workshop (UKPEW' 2002)
University of Glasgow, UK, July 10-11 2002.

In this research, we approach the problem of grid workload management with the development of a multi-tiered architecture that employs performance prediction and a hierarchy of homogeneous brokers to meet quality-of-service contracts and improve resource efficiency. By coupling application performance data with iterative heuristic algorithms, the framework is able to balance the processes of minimising run-to-completion time (makespan) and idle time, whilst adhering to service deadlines on a per-task basis. This paper provides a brief introduction to the architecture, and then focuses on the lowest tier which is responsible for scheduling tasks on grid-enabled resources. Experimental results demonstrate that these components are able to adjust to the conflicting requirements of system metrics and QoS contracts in real-time, using the just-in-time capabilities of the PACE prediction environment and the iterative workload management algorithms.

Grid Information Services using Software Agents
H. N. Lim Choi Keung, J. Cao, D. P. Spooner, S. A. Jarvis, and G. R. Nudd
Eighteenth Annual UK Performance Engineering Workshop (UKPEW' 2002)
University of Glasgow, UK, July 10-11 2002, pp. 187-198.

Computational grids allow large-scale, pervasive and consistent sharing of geographically dispersed resources. Their inherent nature incorporates issues including the discovery of resources located in different administrative domains, predicting the performance of those resources and monitoring their behaviour. The Monitoring and Discovery Service (MDS), one of the pillars provided by the Globus toolkit, can be used to offer Grid information services to an existing agent-based resource advertisement and discovery system. This paper presents an agent system which implements the GRid Information Protocol (GRIP) and the GRid Registration Protocol (GRRP) of the MDS to discover virtual organisations and monitor their respective resources. The resulting system has the effect of resource brokering, monitoring and performance prediction.

Application Response Measurement of Distributed Web Services
J.D.Turner, D.Bacigalupo, S.A.Jarvis, D.N.Dillenberger, G.R.Nudd
CMG International Journal of Computer Resource Management, 108, pp. 45-55, 2002

Web service technology will provide a platform for next generation dynamic e-business

applications. This paper describes a framework for identifying, monitoring and reporting performance data of critical transactions within a web service using the Java ARM standard, a Transaction Definition Language (TDL) and a bytecode instrumentation tool. The data extracted using this framework can be used as part of a service selection and routing algorithm, an example of which is described in this paper. A case study is provided using Gourmet2Go, a demonstrator supplied with the IBM web services toolkit. The results show how transaction-based performance monitoring can be used as a basis for dynamic service routing.

ARMS: an Agent-based Resource Management System for Grid Computing.
J.Cao, S.A.Jarvis, S.Saini, D.J.Kerbyson and G.R.Nudd.
To appear in Scientific Programming, Special Issue on Grid Computing.
IOS Press, 2002.

Resource management is an important component of a grid computing infrastructure. The scalability and adaptability of such systems are two key challenges that must be addressed. In this work an agent-based resource management system, ARMS, is implemented for grid computing. ARMS utilises the performance prediction techniques of the PACE toolkit to provide quantitative data regarding the performance of complex applications running on a local grid resource. At the meta-level, a hierarchy of homogeneous agents are used to provide a scalable and adaptable abstraction of the system architecture. Each agent is able to cooperate with other agents and thereby provide service advertisement and discovery for the scheduling of applications that need to utilise grid resources. A case study with corresponding experimental results is included to demonstrate the efficiency of the resource management and scheduling system.

Agent-based Resource Management for Grid Computing
J. Cao, D. P. Spooner, J. D. Turner, S. A. Jarvis, D. J. Kerbyson, S. Saini, and G. R. Nudd.
2nd IEEE International Symposium on Cluster Computing and the Grid.
Berlin, Germany, May 2002.

It is envisaged that the grid infrastructure will be a large-scale distributed software system that will provide high-end computational and storage capabilities to differentiated users. A number of distributed computing technologies are being applied to grid development work, including CORBA and Jini. In this work, we introduce an A4 (Agile Architecture and Autonomous Agents) methodology, which can be used for resource management for grid computing. An initial system implementation utilises the performance prediction techniques of the PACE toolkit to provide quantitative data regarding the performance of complex applications running on local grid resources. At the meta-level, a hierarchy of identical agents is used to provide an abstraction of the system architecture. Each agent is able to cooperate with other agents to provide service advertisement and discovery to schedule applications that need to utilise grid resources. A performance monitor and advisor (PMA) is in development to optimise the performance of agent behaviours.

Performance Prediction Technology for Agent-based Resource Management
J. Cao, S. A. Jarvis, D. P. Spooner, J. D. Turner and G. R. Nudd.
11th IEEE Heterogeneous Computing Workshop (HCW02).
Marriott Marina, Fort Lauderdale, Florida. 15-19th April 2002.

Resource management constitutes an important infrastructural component of a computational

grid environment. The aim of grid resource management is to efficiently schedule applications over the available resources provided by the supporting grid architecture. Such goals within the high performance community rely, in part, on accurate performance prediction capabilities.

This paper introduces a resource management infrastructure for grid computing environments. The technique couples application performance prediction with a hierarchical multi-agent system. An initial system implementation utilises the performance prediction capabilities of the PACE toolkit to provide quantitative data regarding the performance of complex applications running on local grid resources. The validation results show that a high level of accuracy can be obtained, that cross-platform comparisons can be easily undertaken, and that the estimates can be evaluated rapidly. A hierarchy of homogeneous agents are used to provide a scalable and adaptable abstraction of the grid system architecture. An agent is a representative of a local grid resource and is considered to be both a service provider and a service requestor. Agents are organised into a hierarchy and cooperate to provide service advertisement and discovery. A performance monitor and advisor has been developed to optimise the performance of the agent system. A case study with corresponding experimental results are included to demonstrate the efficiency of the resource management and scheduling system.

The main features of the system include: hard quality of service support using PACE performance prediction capabilities; agent-based dynamic resource advertisement and discovery capabilities; simulation-based quantitative grid performance analysis and user-oriented scheduling of local grid resources.

A Transaction Definition Language for Java Application Response Measurement
J.D. Turner, D.P. Spooner, J. Cao, S.A. Jarvis, D.N. Dillenberger, G.R. Nudd.
27th International Conference on Technology Management and Performance Evaluation of Enterprise-Wide Information Systems (CMG2001)
2-7 December 2001, Anaheim, California.
Published in Journal of Computer Resource Measurement, 105, pp.55-65, 2001.

This paper describes a technique for automatically ARMing Java applications in accordance with the ARM 3.0 standard for Java (submitted to the Open Group February 2001). An XML-based Transaction Definition Language is defined, which allows a developer to semantically define performance critical components of Java applications. An application is instrumented with ARM method calls through a bytecode transformer prior to execution, providing ARM compliance while removing the necessity to modify (or even possess) the original Java source code

High Performance Service Discovery in Large-Scale Multi-Agent and Mobile-Agent Systems.
J. Cao, D.J. Kerbyson, and G.R. Nudd.
International Journal of Software Engineering and Knowledge Engineering, Special Issue on Multi-Agent Systems and Mobile Agents.
World Scientific Publishing, 11(5), 621-641, 2001.

With increasing requirements of distributed software systems, software agents are becoming a mainstream technology for software engineering and data management. Scalability and adaptability are two key challenges that must be addressed. In this work a new model is introduced for building large-scale distributed software systems with high dynamics, using a hierarchy of homogeneous agents that has the capability of service discovery. The performance

of the agent system can be improved using di erent combinations of optimisation strategies. A modelling and simulation environment has been developed to aid the performance evaluation process. Two case studies are given and simulation results are included that show the impact of the agent mobility and the choice of performance optimisation strategies on the overall system performance.

Use of Agent-based Service Discovery for Resource Management in Metacomputing Environment.
J. Cao, D. J. Kerbyson, and G. R. Nudd.
In Proceedings of 7th International Euro-Par Conference.
Manchester, UK, Lecture Notes in Computer Science 2150, Springer Verlag, 882-886, August 2001.

A new methodology is presented in this paper for resource management in a metacomputing environment using a hierarchy of homogeneous agents that has the capability of service discovery. The PACE tools are used to provide quantitative data concerning the performance of sophisticated applications running on local high performance resources. At metacomputing level, an agent hierarchy is used to model the resource management system, and the implementation of resource management, scheduling, and allocation can be abstracted to the processes of service advertisement and service discovery. Different optimisation strategies can be used to improve the performance of the agent system.

Application Characterisation using a Lightweight Transaction Model
D.P. Spooner, J.D. Turner, J. Cao, S.A. Jarvis, G.R. Nudd.
In proc. of *UK Performance Engineering Workshop Leeds 2001, pp. 215-225.*

With the emergence of GRID environments and distributed systems with dynamic resources and varying user profiles, there is an increasing need to develop reliable tools that can ef-fectively coordinate the requirements of an application with available computing resources. The ability to predict the behaviour of complex aggregated systems under dynamically changing workloads is particularly desirable, leading to effective resource usage and opti-misation of networked systems.

To explore these issues, the High Performance Systems Group (HPSG) at Warwick are developing a resource management architecture called PACE Lite that builds upon an exist-ing set of research tools used in the area of performance prediction. The system embodies the concept of a transaction that encapsulates a key application component. Using software sensors, user requirements, system policies and resource usage histories, an application is rapidly characterised and scheduled appropriately. A distributed agent-based environment is used as the system infrastructure, and scheduling optimisation is achieved by a genetic algorithm that attempts to minimise the make-span across systems.

Dynamic Optimisation of Application Execution on Distributed Systems.
A.M. Alkindi, D.J. Kerbyson, E. Papaefstathiou, and G.R. Nudd.
Future Generation Computing Systems, Vol. 17, No. 8, Elsvier, June 2001, pp. 941-949.

In this paper, we demonstrate the impact of a using dynamic (on-the-fly) performance prediction tool-set, PACE, for optimising application execution on dynamic systems. The need for steering the application execution arises from the ever-growing use of distributed and GRID

systems. The unquestionable aim to overcome bottleneck problems, allocation, and performance degradation due to shared CPU time has prompted many investigations into the best way in which the performance of an application can be enhanced. In this work, we present a novel approach to dynamically optimise the performance of an application. An example application, the FFTW (the fastest Fourier transform in the west), is used to illustrate the approach which itself is a novel method that optimises the execution of an FFT. It is shown that the performance prediction can provide the same quality of information as a measurement preocess for application optimisation but in a fraction of the time and thus improve overall application performance.

Dynamic Instrumentation and Performance Prediction of Application Execution.
A.M. Alkindi, D.J. Kerbyson, and G.R. Nudd.
In Proc. of High Performance Computing and Networking (HPCN2001),
Lecture Notes in Computer Science, Vol. 2110, Springer-Verlag, Amsterdam, June 2001, pp. 313-323.

This paper presents a new technique that enhances the process and the methodology used in a performance prediction analysis. An automatic dynamic instrumentation methodology is added to Warwick's Performance Analysis and Characterization Environment PACE. The automation process has eliminated the need to manually obtain application information and data. The dynamic instrumentation has given PACE the ability to extract and utilize data that were hidden and unobtainable prior to execution. We give two examples to illustrate our methodology. While it was impossible to perform the analysis using the original method due to lack of essential information, the new technique successfully enabled PACE to conduct the prediction analysis in a dynamic environment. The results show that with the automated dynamic instrumentation, the performance predication analysis of dynamic application execution is possible and the results obtained are reliable. We believe that the technique implemented here could eventually be used in other performance prediction tool-sets, and therefore enhance the ways in which the performance of systems and applications is analysed and predicted.

Performance Evaluation of an Agent-Based Resource Management Infrastructure for Grid Computing
J. Cao, D.J. Kerbyson, G.R. Nudd.
In Proceedings of 1st IEEE/ACM International Symposium on Cluster Computing and the Grid.

Brisbane, Australia, 311-318, May 2001.

Resource management is an important infrastructure in the grid computing environment. Scalability and adaptability are two key challenges in the implementation of such complex software systems. In this work we introduce a new model for resource management in a metacomputing environment using a hierarchy of homogeneous agents that has the capability of service discovery. The performance of the agent system can be improved using different combinations of optimisation strategies. A modelling and simulation environment has been developed in this work that enables the performance of the system to be investigated. A simplified model of the resource management infrastructure is given as a case study and simulation results are included that show the impact of the choice of performance optimisation strategies on the overall system performance.

Realistic Image Synthesis of Plant Structures for Genetic Analysis

D. Wang, D.J. Kerbyson, G.J. King and G.R. Nudd.
Image and Vision Computing, Vol. 19, No. 8, Elsevier, May 2001, pp. 517-522.

The objective of this study was to develop a systematic method to restore images of plants using a small number of parameters in order to facilitate investigation of the genetic behaviour of branching patterns by computer models. Based on biological data, a generic methodology for image synthesis of plant structures was proposed. The corresponding algorithms for feature extraction and tuning were designed. Images of plant structures were synthesised with a higher accuracy by a model that was constructed using parametric L-systems. The algorithms were validated by comparing the synthetic images with the real plants. The approach makes it possible to assess the virtual architectures of plants by computer models, instead of real experiments, and to investigate the relationship between plant morphology and their genetic behavious. This may aid the understanding of complex branching patterns that result from a plant's genetic behaviour.

Is Predictive Tracing Too Late for HPC Users?
D.J. Kerbyson, E. Papaefstathiou, J.S. Harper, S.C. Perry, G.R. Nudd.
In: *R.J. Allan, A.Simpson, and D.A. Nicole, eds., High Performance Computing, Plenum Press, 1998.*

An underlying goal in the use of high performance systems is to apply the often quite complex systems to achieve rapid application execution times. The analysis of performance is currently an active research area. Traditionally performance prediction has been used prior to application implementation to explore alternative implementations e.g. different parallelisations, and also in analysing existing codes in order to access the impact of increasing resources, and also to identify bottlenecks.

The aim of a novel prediction system currently under development at Warwick, is to extend the traditional use of performance prediction to encapsulate the full software cycle. It incorporates both pre and post-implementation analysis thus allowing alternatives to be explored prior to committing an application (and its parallelisation) to a system, or to refine an existing implementation. The approach is carefully structured with modular performance models to reflect parts of the whole system (e.g. software components, parallelisation components, and hardware/system performances).

In the work to be presented here, it will be shown how this system is capable of producing predictive traces which allow a detailed analysis of the system performance prior to actual execution. The trace data output from the system is in the PICL format allowing an HPC user to utilise familiar performance monitoring tools. Thus, application execution can be easily viewed, and performance hotspots identified from detailed performance predictions.

An example of Financial Option codes will be utilised to illustrates the benefits of this approach on clusters of workstations. The approach has a potentially large applicability in the HPC domain when applied across a range of target platforms which also allows inter-platform performance comparisons to be made.

Application Execution Steering Using On-the-fly Performance Prediction
D.J. Kerbyson, E. Papaefstathiou, G.R. Nudd.
In: *High Performance Computing and Networking 98, Amsterdam, Holland,April 1998, Lecture Notes in Computer Science, Springer-Verlag.*

The execution of an application on a high performance system requires parameters concerning the problem in hand, and those that determine the system mapping, to be specified by a user. The system parameters are typically used to minimise the execution time. However, by the coupling of a performance model with an application, system parameters can be determined without user intervention. In the work presented here, a novel performance prediction system has been used to provide suitable performance models which can determine application mapping parameters, code execution decisions, and system choices on-the-fly. An example compact application of a convolution is used to illustrate the approach for automatically choosing the actual code to be executed, and the number of workstations in a cluster to be utilised. The performance prediction system is shown to have a reasonable accuracy (approximately 10% error), with a rapid evaluation time (typically less than 2s).

Predicting the Cache Miss Ratio of Loop-Nested Array References
J.S. Harper, D.J. Kerbyson, G.R. Nudd.
Research Report 336, Department of Computer Science, University of Warwick, Coventry, UK, December 1997.

The time a program takes to execute can be massively affected by the efficiency with which it utilizes cache memory. Moreover the cache-miss behavior of a program can be highly unpredictable, in that small changes to input parameters can cause large changes in the number of misses. In this paper we present novel analytical models of the cache behavior of programs consisting mainly of array operations inside nested loops, for direct-mapped caches. The models are used to predict the miss-ratios of three example loop nests; the results are shown to be largely within ten percent of simulated values. A significant advantage is that the calculation time is proportional to the number of array references in the program, typically several orders of magnitude faster than traditional cache simulation methods.

An Introduction to the Layered Characterisation for High Performance Systems
E. Papaefstathiou, D.J. Kerbyson, G.R. Nudd, T.J. Atherton, J.S. Harper.
Research Report 335, Department of Computer Science, University of Warwick, Coventry, UK, December, 1997.

A toolset for performance analysis of parallel systems, PACE, is presented in this report. In this toolset expert knowledge about the performance evaluation techniques is not required as a prerequisite for the user. Instead a declarative approach to the performance study is taken by describing the application in a way that is both intuitive to the user, but can also be used to obtain performance results. The underlying performance related characterisation models and their evaluation processes are hidden from the user. This document describes the special purpose language, and the evaluation system, that form the core of the PACE toolset. Amongst the aims of the toolset is the support of characterisation model reusability, ease of experimentation, provide different levels of prediction accuracy, and support of different levels of characterisation model abstraction.

PACE: A Toolset to Investigate and Predict Performance in Parallel Systems
D.J. Kerbyson, J.S. Harper, A. Craig, G.R. Nudd.
Presented in European Parallel Tools Meeting, ONERA, Paris, October 1996.

A toolset, PACE for predicting and analysing performance issues in parallel systems is presented here. In this toolset expert knowledge about performance evaluation techniques is not

required as a prerequisite for its use. Instead, an intuitive approach is taken by describing the application under study in way that is accessible to the user. A modular approach is taken which permits separate descriptions of sub-tasks, parallelisation strategies, and platform descriptions to take place. PACE has been used to predict performance for number of applications on a number of different parallel platforms. Results to date have indicated that the predictions typically within 5-7% of actual measurements.

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1 Compiling performance models from parallel programs

Arjan J. C. van Gemund

July 1994 **Proceedings of the 8th international conference on Supercomputing**

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A technique is described to automatically compile performance models in the course of program translation. The performance models are fully symbolic in order to preserve as much diagnostic information as possible. Although compiled statistically, the models account for the effects of resource contention, due to the introduction of a novel algorithm within the symbolic compilation scheme. It is shown that the compilation approach fundamentally outperforms traditional static estimation proced ...

2 Performance evaluation of software architectures

Lloyd G. Williams, Connie U. Smith

October 1998 **Proceedings of the first international workshop on Software and performance**

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3 Extending performance approaches to new application domains: PRIMAmob-UML: a methodology for performance analysis of mobile software architectures

Vincenzo Grassi, Raffaela Mirandola

July 2002 **Proceedings of the third international workshop on Software and performance**

Full text available: pdf(252.87 KB) Additional Information: full citation, abstract, references

Different paradigms (client-server, mobility based, etc.) have been suggested and adopted to cope with the complexity of designing the software architecture of distributed applications for wide area environments, and selecting the "best" paradigm is a typical choice to be made in the very early software design phases. Several factors should drive this choice, one of them being the impact of the adopted paradigm on the application performance. Within this framework our contribution is as follows: ...

Keywords: UML, architecture modelling, distributed systems, mobile components, performance analysis

4 The coordinated use of five performance evaluation methodologies
Gordon E. Anderson
February 1984 **Communications of the ACM**, Volume 27 Issue 2

Full text available: pdf(581.63 KB) Additional Information: full citation, abstract, references, citings, index terms

Information system design can be influenced and ultimate performance parameters accurately forecast through the coordinated use of five performance analysis tools. The complementary methodology is used to first predict and then validate system performance throughout its life cycle.

Keywords: hardware monitor, load simulator, model validation, queueing network model, simulation model, software performance engineering, work-load characterization

5 The evolution of software performance engineering: a survey
Connie U. Smith
November 1999 **Proceedings of 1986 fall joint computer conference on Fall joint computer conference**
Full text available: pdf(486.64 KB) Additional Information: full citation, references, index terms

6 Performance evaluation of software architecture: Process models for the software development and performance engineering tasks
Andreas Schmietendorf, Evgeni Dimitrov, Reiner R. Dumke
July 2002 **Proceedings of the third international workshop on Software and performance**
Full text available: pdf(146.38 KB) Additional Information: full citation, abstract, references

This research paper investigates and evaluates the currently available process models for software development with respect to representation of software performance engineering (SPE) tasks. The deficits identified point to the need to expand existing process models to include this task. On the basis of an process model for object-oriented development, a so called PM-OO^{PE} is proposed to illustrate the subject, which allocates necessary SPE activities to the development process in a ph ...

Keywords: performance analysis, performance modeling, performance related risks, process model, software development, software performance engineering

7 A methodology for tuning and verifying package simulation models
David C. Efron
August 1975 **Proceedings of the 1975 symposium on Simulation of computer systems**

Full text available: pdf(790.87 KB) Additional Information: full citation, abstract, references, citings, index terms

The computer system simulation packages are generally regarded as being capable of producing viable performance projections quickly and cheaply relative to the time and cost of programming unique simulation models. Many users also recognize that simulation models cast in the prescribed molds of the packages may be subject to various errors. They will therefore consider all results as coarse indications of expected performance levels. In contrast, this paper demonstrates how the p ...

8 Data, definition, deduction: An empirical view of operational analysis
Springer Cox
March 1982 **Proceedings of the 1982 workshop on Software metrics**

Full text available: pdf(396.07 KB) Additional Information: full citation, abstract, references, index terms

The theoretical aspects of operational analysis have been considered more extensively than matters of its application in practical situations. Since its relationships differ in their applicability, they must be considered separately when they are applied. In order to do this, the foundations of three such relationships are examined from an empirical point of view. To further demonstrate the intimate connection between data, definitions, and performance models, the problem of meas ...

9 Parallel Discrete-Event Simulation (PDES): a case study in design, development, and performance using SPEEDES
Frederick Wieland, Eric Blair, Tony Zukas
July 1995 **ACM SIGSIM Simulation Digest , Proceedings of the ninth workshop on Parallel and distributed simulation**, Volume 25 Issue 1

Full text available: pdf(1.19 MB) Publisher Site Additional Information: full citation, abstract, references, citings, index terms

Can parallel simulations efficiently exploit a network of workstations? Why haven't PDES models followed standard modeling methodologies? Will the field of PDES survive, and if so, in what form? Researchers in the PDES field have addressed these questions and others in a series of papers published in the last few years [1,2,3,4]. The purpose of this paper is to shed light on these questions, by documenting an actual case study of the development of an optimistically synchronized PDES applic ...

Keywords: SPEEDES, aerospace computing, aerospace simulation, communications network, conceptual design, discrete event simulation, flight simulation, implementation, network of workstations, operations research, optimistically synchronized PDES, parallel discrete-event simulation, performance, validation

10 Using UML models for performance calculation
Fried Hoeben
September 2000 **Proceedings of the second international workshop on Software and performance**

Full text available: pdf(80.51 KB) Additional Information: full citation, references, citings, index terms

Keywords: UML, abstractions, automated performance estimates, component based systems, distributed systems, performance engineering

11 Performance modeling and analysis: Two approaches to integrating UML and performance models
R. P. Hopkins, M. J. Smith, P. J. B. King
July 2002 **Proceedings of the third international workshop on Software and performance**

Full text available: pdf(68.26 KB) Additional Information: full citation, references

12 Software engineering and performance: a roadmap
Rob Pooley

May 2000 **Proceedings of the conference on The future of Software engineering**

Full text available: pdf(692.82 KB) Additional Information: full citation, references, citings, index terms

Keywords: performance engineering, software engineering

13 Deriving performance models of software architectures from message sequence charts

F. Andolfi, F. Aquilani, S. Balsamo, P. Inverardi

September 2000 **Proceedings of the second international workshop on Software and performance**

Full text available: pdf(746.71 KB) Additional Information: full citation, references, citings, index terms

Keywords: MSCs, performance evaluation, performance indices, queueing network model, software architecture

14 The role of computer system models in performance evaluation

Stephen R. Kimbleton

July 1972 **Communications of the ACM**, Volume 15 Issue 7

Full text available: pdf(502.00 KB) Additional Information: full citation, abstract, references, citings

Models constitute a useful means of investigating computer system performance. This paper examines the interrelationships between models and other methods for evaluating the performance of computer systems and establishes circumstances under which the use of a model is appropriate.

Keywords: analytic-models, evaluation, modeling, performance, simulation-models, system-models

15 Computer system models: An introduction

Herb Schwetman

September 1981 **Proceedings of the 1981 ACM SIGMETRICS conference on Measurement and modeling of computer systems**

Full text available: pdf(42.05 KB) Additional Information: full citation, abstract, references, index terms

A system model is a tool used to predict system performance under changing conditions. There are two widely used modeling techniques: one based on discrete event simulation and one based on queuing theory models. Because queueing theory models are so much cheaper to implement and use, as compared to simulation models, there is growing interest in them. Users are developing and using queuing theory models to project system performance, project capacity, analyze bottlenecks and configure syst ...

16 A performance engineering tool and method for distributing applications

M. Litoiu, Hamid Khafagy, Bin Qin, Anita Rass Wan, J. Rolia

November 1997 **Proceedings of the 1997 conference of the Centre for Advanced Studies on Collaborative research**

Full text available: pdf(188.01 KB) Additional Information: full citation, abstract, references, index terms

Recent advances in distributed object and Internet technologies have made it attractive for organizations to distribute application functions. Typical projects include: the re-hosting of legacy applications that move application functionality to or from mainframe/server environments, the creation of new target independent interfaces for legacy systems, and the

development of new applications altogether. Design concerns for such systems include security, reliability, and performance. The performa ...

Keywords: distributed computing, performance analysis, performance modeling, software design

17 Performance modeling and analysis: Unified system builder through interacting blocks (*USBIB*) for soft real-time systems

Nunzio-Nicoló Savino-Vazquez, Juan-Luis Anciano, Carlos Juiz

July 2002 **Proceedings of the third international workshop on Software and performance**

Full text available: pdf(167.41 KB) Additional Information: full citation, abstract, references, index terms

From the functional point of view, one of the most usual approaches to carry out real-time system design is based on the concept of a system as a set of software modules such as activities collaborating through interaction protocols. Considering the performance of such systems becomes essential. Unfortunately, software methods for designing real-time systems do not usually provide any performance facility.This paper presents the *Unified System Builder trough Interacting Blocks (USBIB)* as ...

Keywords: MASCOT, performance modelling software components, real-time systems

18 Visual representation of stochastic process algebra models

Nigel Thomas, Malcolm Munro, Peter King, Rob Pooley

September 2000 **Proceedings of the second international workshop on Software and performance**

Full text available: pdf(28.65 KB) Additional Information: full citation, references, index terms

Keywords: model comprehension, process algebra, visualisation

19 Automatic generation of performance models for distributed application systems

M. Qin, R. Lee, A. El Rayess, V. Vetland, J. Rolia

November 1996 **Proceedings of the 1996 conference of the Centre for Advanced Studies on Collaborative research**

Full text available: pdf(105.99 KB) Additional Information: full citation, abstract, references, index terms

Organizations have become increasingly dependent on computing systems to achieve their business goals. The performance of these systems in terms of response times and cost has a major impact on their effectiveness. To achieve openness and scalability, these systems have begun to rely on distributed environment technologies such as the Open Software Foundation's Distributed Computing Environment (DCE) and the Object Management Group's Common Object Request Broker Architecture (CORBA). The resulti ...

Keywords: distributed applications, performance evaluation, performance management

20 Parameter interdependencies of file placement models in a Unix system

Alfredo de J. Perez-Davila, Lawrence W. Dowdy

January 1984 **Proceedings of the 1984 ACM SIGMETRICS conference on Measurement and modeling of computer systems**

Additional Information: full citation, abstract, references, citings, index terms

A file assignment case study of a computer system running Unix is presented. A queueing network model of the system is constructed and validated. A modeling technique for the movement of files between and within disks is proposed. A detailed queueing network model is constructed for several file distributions in secondary storage. The interdependencies between the speed of the CPU, the swapping activity, the visit ratios and the multiprogramming level are examined and inclu ...

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5 **Agent-based resource management for grid computing**
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E. Papaefstathiou
September 2000 **Proceedings of the second international workshop on Software and performance**
Full text available: pdf(341.34 KB) Additional Information: full citation, references, citings, index terms

Keywords: infrastructure, parallel/distributed systems, performance prediction and analysis, responsive software

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E. Papaefstathiou, D. J. Kerbyson, G. R. Nudd, J. S. Harper, S. C. Perry, D. V. Wilcox
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